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or Atlantic. They sailed by day, putting into harbor at night, and never losing sight of land unless driven by stress of weather. At first they sailed only with the wind, but by slow degrees they learned to tack; then decks were built over the stern and prow, leaving the mid-ships exposed to the high seas. This class of vessels, sometimes with banks of oars, continued until the middle of the last century. In the early part of the fifteenth century smaller but stronger vessels of better material were built for the voyages of discovery undertaken by the Portuguese. At this time also the mariner's compass was brought into general use, having been introduced from Arabia; eighty years later it found its way to England. Two of the vessels of Columbus were decked only at the prow and stern, and the three were manned by one hundred and twenty men.

The Armada of Queen Elizabeth was formed of merchant vessels fitted up as men of war, and not until the time of Charles the First were there any regular ships of war in England or, probably, in other countries.

Commerce was usually carried on by companies, with rules regulating the quantity of goods to be exported, so that the market should not be overstocked and unremunerative prices obtained. Sometimes the merchant was owner of the vessel, who adventured with his cargo and sailed in his own ship. The ships were constructed with little reference to speed, sailing forty or fifty miles a day.¹

The steam engine came into use near the middle of the eighteenth century in England, and two generations passed before it was used on vessels. The first steamboat ran on the Hudson in 1807, in England in 1812. Then another generation passed before the ocean was crossed by the "Sirius" and "Great Western" in 1833. These ships sailed from seven to eight knots an hour. Ten years later iron ships were built; then came the propeller, the invention of Ericsson, followed by vessels built of steel, and lastly the "City of Paris" and "Majestic," carrying fifteen thousand tons of freight and sailing five hundred knots a day, or twenty knots an hour.

Until the present century all commerce between remote points was by water, excepting in the Roman Empire. After the downfall of Rome there was neither commerce nor travel and no use for roads, the cost of transportation even for a short distance exceeding the value of the goods.

The railroad was introduced about the same time into England and America, and was rapidly extended into every country. The steam-engine on land and water has revolutionized the methods of transportation and created a new commerce. "The movement of goods in a year on all the through routes of the world did not then equal the movement on a single one of our trunk lines of railroad for the same period." Formerly it cost ten dollars to move a ton of freight one hundred miles; now it can be moved thirteen hundred miles for the same sum. The grain and corn from our western lands, then not worth the transportation to the sea coast, are now sold in London, and our prairies yield to the western farmer greater profit than the grain lands of England yield to the farmer there. The land commerce created by steam probably exceeds to-day the commerce carried on the water.

The cost of moving freight by railroads varies greatly in different parts of the United States and in different countries. The highest cost west of the Rocky Mountains is two and a quarter times more than in some of our middle States. The average freight receipts per ton per mile in this country is \$0.922, which is less than those of any other country, although the Belgian and Russian rates are not much higher. In England the rates are from fifty to seventy per cent higher than in America, and in the other countries of Europe higher than in England.

In England and America the railroads are operated by private companies in competition.

In France railroads are operated by private companies regulated by law, the country being divided among different lines of road. Lines are constructed by private companies and run at rates fixed by the government.

¹ The breadth was about one-fourth the length, and not until within forty years were the proportions of one-tenth or one-twelfth of the breadth obtained.

In Belgium and Germany the principal roads are owned and operated by the government.

Our system has yielded the best results to the people.

The commerce which was in olden times transported only twenty or twenty-five miles a day is now moved five hundred miles a day by water and eight hundred miles by land. Correspondence, then carried no faster than freight, is now borne by telegraph to the farthest ends of the world.

All these changes have taken place within a single generation; for our fathers could not travel any faster than Alexander or Caesar. Steamships, railroads, and telegraphs within that time have transformed all commercial transactions and the methods of commercial business. Formerly eight months were required to execute an order in India or China and obtain the return; now one day is sufficient. These commercial changes caused a revolution in the modes of business, and were the main factors which produced the monetary disturbances of 1873, the effects of which we yet feel, so long has it taken the world to adjust itself to its new relations.

The Future of Commerce.

The commerce of the world originated in Asia; it was carried to Africa and thence to Europe, and from Europe to America. This movement can go no further westward, for on the other side of the Pacific is China, which has successfully resisted every attempt of the European to encroach upon her domains, and India with its teeming population of two hundred and fifty millions; so that America, the last of the continents to be inhabited, now receives the wealth of India and Asia pouring into it from the west, and the manufactures and population of Europe from the east. Here the East and West, different from each other in mental power and civilization, will meet, each alone incomplete, each essential to the fullest and most symmetrical development of the other. Here will be the great banking and commercial houses of the world, the centre of business, wealth, and population.

The end is not yet. Inventions are increasing in a geometric rather than an arithmetic progression. The limit of steam-power has not been reached, for with a high temperature in the steam-boiler the addition of a few pounds of coal increases the steam-power so greatly that we are unable either to control or to use it.

Electricity has just begun to offer new opportunities to commerce. We are no longer compelled to carry our factories to the water-power, for by the electric wire the power may be brought to the house of the operative, and we may again see the private workman supersede the factory operative. A few cars and small vessels are moved by electricity — the forerunner of greater things. We know little of this new agency, but its future growth must be more rapid and more wonderful than that of steam.

The secretary of the Smithsonian Institution (Mr. Langley) tells us that "before the incoming of the twentieth century, aerial navigation will be an established fact."

"The deeper the insight we obtain into the mysterious workings of nature's forces," says Siemens, "the more we are convinced that we are still standing in the vestibule of science; that an unexplored world still lies before us; and, however much we may discover, we know not whether mankind will ever arrive at a full knowledge of nature."

LETTERS TO THE EDITOR.

** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Loup Rivers of Nebraska.

PERCEIVING by Professor Hicks's reply (March 4) to my comment (Feb. 19) on his essay on the Evolution of the Loup Rivers (Jan. 29) that I had in part misapprehended his meaning, I have corresponded with him in order to understand more clearly the share that he ascribes to headwater erosion and capture in the development of the present stream courses. As is not infrequently

the case, there is more agreement than difference in our discussion.

My misapprehension arose as follows: In his essay of Jan 29, after speaking of headwater erosion and the subsequent capture or lateral abstraction of certain streams by this process, Professor Hicks wrote, "The latest robbery in the Loup system is that of the headwaters of the Wood River. Journeying down from the headwaters of the South Loup, one is impressed with the apparent continuity of its valley with that of Wood River, rather than with that of the South Loup itself below Callaway. It is obviously an instance of the lower, more easterly stream cutting through the divide and drawing to itself the headwaters of the higher one. This series of captures by lower tributaries is exhibited on a grand scale and in a mature form in the Loup system."

If the reader will refer to the first figure in Professor Hicks's essay, he may understand why I inferred from this sentence that the several other deflected streams, exhibiting the same relative parts as shown in the South Loup and Wood Rivers, constituted the "series of captures" in which the South Loup was "the latest robbery."

It now appears, however, that the head of Wood River was not precisely located in the figure referred to; and that its correction by Professor Hicks in his letter to me places it more as figured by Professor Todd in *Science* for March 11. As thus figured, it is distinctly placed in another category from the streams deflected eastward by flood-plaining.

Professor Hicks refers me to his article on "An Old Lake Bottom" in the second volume of the Bulletin of the Geological Society of America. Mention is there made of certain old valleys of Tertiary erosion, more or less obscured but not entirely concealed by lake sediments of later Tertiary deposition, by which the country is now covered. These old valleys are placed in the same category with the abandoned channel at the head of the Wood River, by which the South Loup is supposed once to have flowed to the Wood, as if headwater erosion by adjacent streams had in all these cases determined the abandonment of the old valleys. But it is still not clear why all these abandoned valleys must be regarded as having lost their former streams by lateral abstraction following headwater erosion. I perceive that the slopes indicated in Professor Hicks's figures are in the proper direction for such abstraction; but it is surprising to find that slopes of so moderate a measure of inclination suffice to give one stream an advantage over another, even to the points of abstraction of this kind. I shall be delighted if this is proved to be the case; for, if so, the process of abstraction and the accompanying rearrangement of divides may be regarded as of very extensive application. As ordinarily explained, the advantage that the capturing stream must possess is much greater than would be found in a region of horizontal and comparatively weak sediments, and of moderate inclination, such as Nebraska.

I shall therefore hope to have a fuller discussion of the problem from Professor Hicks, and an exclusion of other processes as well as a confirmation of the effective action of headwater erosion on so large a scale in producing these changes in Nebraska river courses.

The chief rearrangement of the Loup streams, as shown in Professor Hicks's diagram, being the product of down-stream deflection of the tributaries of a flood-plained river, I find in them a very satisfactory justification of a somewhat hazardous explanation offered in an essay on the Rivers and Valleys of Pennsylvania (*Nat. Geogr. Mag.*, I., 1889, 241) for the down-stream deflection of certain tributaries of the Susquehanna in the central portion of the State. But in this case the flood-plain, by whose growth the tributaries were deflected, is a thing of the imagination. If it ever existed, it has been entirely worn away by the denudation following the later elevation of the region in Tertiary time; the deflected streams, maintaining their specialized courses after uplift, cut down their channel through the imagined flood-plain sediments, and thus became superimposed on the underlying strata, which they now deeply dissect and traverse in a highly inconsequent manner. Professor Todd's diagram gives further illustration of this kind of down-stream deflection of tributaries. All of the branches of the Platte are deflected before reaching the

main stream; the Platte itself is turned down before joining the Missouri; so is the Niobrara.

In this connection I wish to suggest another cause besides the three mentioned by Professor Todd for the north-eastward turn of the Platte at Kearney; namely, the possible spontaneous deflection of the river from its previous more direct course, as, for example, along the Little Blue, by its own action in building up the plain over which it flowed. The rivers of the plains of India frequently change their courses in this fashion; the Hwang-ho devastates the plains of China for the same reason. May not the Platte have once had the same shifty habit? The Garonne, in south-western France, is a still more striking example of a spontaneous avoidance of its former course. Much of the waste borne out from the Pyrenees by the Garonne and its fellows now forms a flat, delta-like surface, of radial slope from the point where the larger rivers issue from the mountains; but, instead of pursuing a direct course northward, the Garonne turns sharply to the east at the foot of the mountains; while numerous small streams run down the slope of the radial alluvial deposit. Perhaps in the same way the Little Blue and the branches of the Big Blue Rivers may represent the old courses of the Platte, abandoned for a newer course of lower grade.

There are two other questions that I should like to ask of western observers. Is there generally perceptible a right-handed deflection of the rivers on the plains, as if in consequence of the earth's rotation? Can examples be given of the lateral abstraction of one stream by another on a slope of planation, after the fashion described by Gilbert in his report on the Henry Mountains some years ago?

W. M. DAVIS.

Cambridge, Mass., April 7.

The Persistency of Family Traits.

THERE are one or two points bearing on the subject at the head of this article that were not mentioned by either of the writers in the issue of March 18. The first is that the mother in placental mammals tends to assimilate in respect to blood to the father, as the blood of the mother passes through the young *in utero* and therefore the strain of blood derived from the father is shared by the young with the mother. A study of family history carried on for almost twenty-five years shows that there is generally a running to what are called "family types" among the youngest of a numerous family, and the type is that of the paternal family. It is too well known to need argument that the mother frequently acquires diseases belonging to the father indirectly through the child she is carrying. It is also well known that an old couple tend to assimilate in facial and bodily appearance, and the change, as shown by numerous instances, is generally in the female, as the above facts would call for. We can see that each child in a family finds the mother more and more impregnated with the blood of the paternal house, and it is not strange if the children favor the family that gives them the name.

The other fact is that the pregnant mother is more readily influenced by whims than in any other state. From classical times to the present it has been the aim of those about a woman in such a state to make life as pleasant as possible. While we may no longer surround her with beautiful statuary and other paraphernalia of a Roman household, we recognize that her whims may fix the character as well as permanently mark the coming child. We drive a gravid mare in a light wagon that the foal may be amenable to discipline. As the generality of married people associate more with the family that carries the name, it follows that the mother is affected by sympathy or antipathy for that family, and both lead her to dwell on the features and forms of its members, so that the child runs a good chance of bearing either or both. Birth-marks do not exist in fiction only, and though the bloody horse-shoe of Redgauntlet may be lacking, there are other signs to show the horror or antipathy of a terrified or whimsical mother. In a love match, the face of the father is reproduced, or, as the French proverb says, "The love child resembles the father." A union, therefore, of the two conditions noted above will cause the children to favor the race that carries the name rather than to run toward the spinster side, even were there nothing like reversions